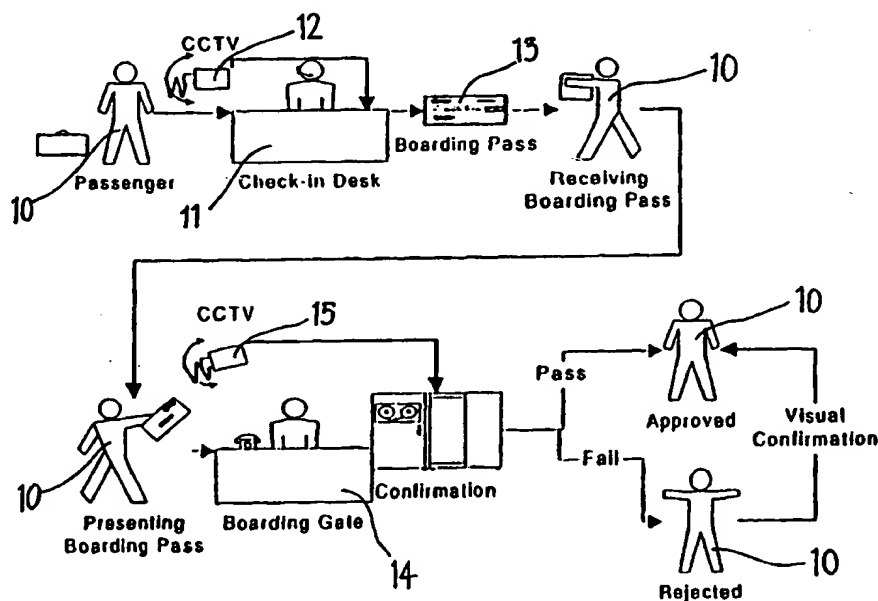




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : G07C 9/00, G07B 15/00		A1	(11) International Publication Number: WO 00/28485
			(43) International Publication Date: 18 May 2000 (18.05.00)
(21) International Application Number: PCT/GB99/03722		(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).	
(22) International Filing Date: 8 November 1999 (08.11.99)			
(30) Priority Data: 9824468.4 7 November 1998 (07.11.98) GB 9905299.5 8 March 1999 (08.03.99) GB 9917955.8 31 July 1999 (31.07.99) GB			
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		Published With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.	

(54) Title: IDENTITY SYSTEM



(57) Abstract

A method of operating an identity system includes obtaining images of a plurality of persons (10) at a first location (11) using a digital camera (12) linked to a computer which is programmed to analyse the biometric data in the images to produce a template for each person, the templates are converted to multi-dimensional bar codes which are applied to data carriers (13). The bar codes on the data carriers (13) are then scanned at a second location (14) using scanning means linked to display means for displaying the images.

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IDENTITY SYSTEM**Field of the Invention**

This invention relates to identity systems.

In PCT Application No. PCT/GB98/01041 (Publication No. WO 98/44846) to which reference should be made, there is disclosed a method of producing an identity system applicable to the identification of a plurality of persons, said method comprising taking a photograph of each of the persons, assigning an identity code to each photograph, and producing a record sheet for each person, which record sheet carries a photograph, the name of the person shown in the photograph and the associated assigned identity code.

It is an object of the present invention to provide an improved method of producing and using an identity system.

Summary of the Invention

According to a first aspect of the present invention, there is provided a method of producing and using an identity system, which method includes obtaining images of a plurality of persons, each of which images is obtained using a digital camera linked to a computer programmed to analyse the biometric data in the images to produce a template for each of the persons, converting the templates to multi-dimensional bar codes, applying the multi-dimensional bar codes to data carriers, and scanning the bar codes using scanning devices linked to display means for displaying the images.

According to a second aspect of the present invention there is provided a method of producing an identity device, which method includes obtaining a plurality of images of a person, each of which images is obtained using a digital camera linked to a computer programmed to analyse the biometric data in the images to produce a plurality of biometric templates, one for each of said images, the computer further being programmed to assess the plurality of biometric templates associated with that person and to recognise differences between the templates, the computer then generating data concerning the two templates of maximum difference, which data is converted into a multi-dimensional bar code which is applied to a data carrier to produce the identity device.

The data carriers may be in the form of identification cards, bank cards, record sheets, airline boarding passes or the like, depending on the particular application of the system.

Each data carrier may also be printed with a digital photograph of the relevant person and/or other appropriate information.

The data carrier may also be a "SMART" card which incorporates a small denomination chip, e.g. a 1k or 2k chip, for rewriteable data and the multi-dimensional bar code for fixed data.

The multi-dimensional bar code may additionally include biometric data concerning the voice and/or fingerprint of the person concerned.

If the data carrier is an airline boarding pass, the multi-dimensional bar code may also include information concerning any hand luggage being carried by that person. A photograph of the hand luggage is preferably taken by a digital camera and the image of the luggage converted into data encrypted in the bar code.

The identity device carrying the multi-dimensional bar code may be scanned using a scanner linked to display means for displaying an image of the person for whom the identity device was issued.

According to a third aspect of the present invention there is provided a security system, particularly an airport security system, which includes:-

a) a digital camera for obtaining an image of a person at a first point, for example, a passenger checking in at an airport,

b) a computer linked to the digital camera and programmed to analyse the biometric images obtained by the camera to produce a biometric template for each person and to convert the template into a multi-dimensional bar code,

c) means for applying the multi-dimensional bar code to a data carrier, for example, a boarding pass,

d) scanning means at a second point, for example, a departure gate or other departure point, for scanning the bar code on each data carrier, and

e) display means linked to the scanning means to display the image associated with the bar code for comparison with the person or a photograph of the person presenting the data carrier.

The digital camera preferably obtains a plurality of images of each person and the computer is preferably programmed to assess the plurality of biometric templates associated with each person and to recognise differences between the templates, the computer then generating data concerning the two templates of maximum difference and this data being converted into the multi-dimensional bar code.

According to a further aspect of the present invention there is provided a method of affording security, for example, at an airport, which method includes:-

a) obtaining an image of each person at a first location, for example, of a person checking in at an airport, using a digital camera,

b) providing a computer which is linked to the digital camera and is programmed to analyse the biometric data in the images to produce a biometric template for each person,

c) converting the template to a multi-dimensional bar code,

d) applying the multi-dimensional bar code to a data carrier, for example, a boarding pass,

e) providing scanning means at a second location, for example, a departure gate or other departure point, for scanning the bar code on each data carrier, and

f) providing display means linked to the scanning means to display the image associated with the bar code.

Means may be provided for comparing the image associated with the bar code with the image of the person presenting the data carrier, e.g. boarding pass.

If desired, all the information concerning the passengers on a particular aircraft can be collated and sent, either on a disc carried on the aircraft or by electronic transmission, to the airport at which the aircraft is due to land so that the information can also be used at the aircraft's destination.

Brief Description of the Drawing

The single figure of the accompanying drawing is a schematic illustration of the mode of operation of an airport security system.

Description of the Preferred Embodiments

The identity system of the present invention is capable of many applications, as described in detail below and involves two quite separate stages, i.e. the encryption stage, in which information is applied to a data carrier, and an interpretation stage, in which the information applied to the data carrier is interpreted.

In the encryption stage, an image of an individual is captured using a digital camera linked to a computer. Four to six photographs will normally be taken at very short intervals of time and the biometric information obtained by the taking of the photographs is analysed in the computer using appropriate software, for example, the "TrueFace" TM software produced by Miros Inc. to produce templates.

The computer is programmed to analyse the biometric data in each of the images obtained by the digital camera and produces a plurality of biometric templates, one for each of the images. Although the images will all be taken in a matter of microseconds, there will be differences between the individual images and the

computer is programmed to recognise differences between the templates. The computer determines which two of the templates are of maximum difference and then generates data concerning these two templates.

The template data is then compressed and added to data concerning the individual, e. g. name, address, date of birth, medical record, passport number, National Insurance number, etc. The data is then converted into a multi-dimensional bar code, e.g. a two-dimensional bar code in accordance with the PDF417 format of Symbol Technologies. Other bar code formats may be employed, as desired, including three-dimensional bar codes when available.

If required, the biometric templates for the individual's voice and fingerprint are captured using proprietary software and added to the main programme for integration with the data which is converted into the multi-dimensional bar code.

The multi-dimensional bar code is then printed on to a data carrier, such as a bank card, identification card, record sheet, airline boarding pass or the like, together with a digital photograph of the individual concerned (if so required) and any other relevant information.

In the interpretation stage, the two-dimensional bar code is scanned using a scanning device, for example, a scanning device produced by Symbol Technologies. Scanning may be effected using a card reader with a combined digital camera facility, so as to

produce a photograph of the person corresponding to the bar code. Alternatively, scanning may be effected using a scanner directly linked to a computer connected to a monitor, e.g. a CCTV monitor, to display the image of the person concerned. If the bar code includes data concerning the voice and/or fingerprint of the person, a voice and/or fingerprint reading facility will be provided to enable a comparison to be made between the voice and/or fingerprint of a person presenting the data carrier and the person concerning whom the bar code contains the relative data.

The single figure of the accompanying drawing shows the application of the invention to an airport security system, though other applications of the invention will be readily apparent. It is to be appreciated that the specific references to airport security are given by way of example.

In the enrolment process, a series of images are captured from a live video feed used CCTV (or other form of digital camera) linked to a computer operating a face recognition programme. The image capture process can be automatic or via a touch screen or mouse control. The image is then cropped and the resulting face converted into a facial biometric template. This template is then fed back to the live image where a further template is produced. These two templates are then compiled to achieve either a match or a confidence level.

The methodology employed will only allow the process to occur if the following conditions are in place:-

a) the verification (confidence) level which is achieved is at or above a pre-set threshold which is adjustable by the operator,

b) the template will be retained if it falls within a range of sizes that do not exceed the storage medium capacity; this is a variable factor and under the control of the operator, and

c) in the event of a poor or low value template being produced there may be a situation where, despite further attempts, the template fails to reach the desired value. In this situation, the template, when stored, will have added to it text information confirming the value and asking for visual comparison with the photograph (if stored).

Once the desired template has been selected, this will be converted into the storage medium, i.e. multi-dimensional bar code, smart card or combination, along with other information depending on the exact system requirements.

At the time of verification, the biometric data is read by a scanner, smart card reader or other device and entered into the program. The stored template is then compared to rapidly generated templates taken from a live person. The verification system will automatically compare the stored template to the newly generated templates until such time as the templates either have a perfect match or the new templates reach a pre-set threshold. For additional security, the photograph taken at the time of enrolment can be displayed. Once the templates are formed, the process will take only a matter of microseconds to complete and, on verification, the card holder will be granted access.

The exception to the above is where the initial enrolment template fell below the threshold. In this case, an operator will be asked to confirm the photograph visually and view the individual verification (confidence) level which will be displayed alongside the photograph.

In the airport security system, as shown in the drawing, a passenger 10 presents a ticket at the check-in desk 11 and details of the passenger and journey are entered in a computer. When requested, the passenger 10 is identified by using a touch screen, which captures a photograph plus a templifying image. A motorised digital camera 12 is mounted so that it can be angled to capture all heights of passengers and wheelchair occupants. The head height of the passenger 10 is recorded at this point to speed up the verification process at the departure gate. The check-in desk operator then carries out the same procedure with the passenger's luggage, which is viewed from a separate video camera.

A boarding pass 13 is then printed with a two-dimensional bar code containing two facial templates, a colour head and shoulders photograph, photographs of luggage, including hand luggage, and all passenger and flight information recorded at the time of check-in. The recorded details may include any medical, allergy or dietary information. Provision may also be made within the storage area to store further biometric data if required, for example, concerning the hand, finger, voice or iris of the passenger. The bar codes may be, for example, QR and AZTEC code, and can be printed in clusters of

either three or four. Each individual 3 X 3 cm. Block has 1200+ bytes of data, providing a total of 3600 or 4800 bytes.

Luggage tags are then printed and attached. These contain standard bar codes for automated routing but, in addition, they are printed with the same basic passenger and flight information shown on the boarding pass 13.

When called, the passenger 10 presents the boarding pass 13 at the boarding gate 14, where the boarding pass 13 is scanned with an image reader. A camera 15 focused on the departure gate then captures a live image of the passenger 10 to compare with the stored template. The passenger's height details, which were captured at check-in, now allow the camera 15 to be targeted within a few centimetres of the head position. The boarding gate operator is able to view a colour photograph of the passenger plus acknowledgement of verification in an appropriate language. In the event of non-verification, a message will appear in an appropriate language and the passenger will be advised that they need staff intervention. Officers can use a photo image to manually verify a passenger.

Apart from its specific application to airport security, the invention provides a number of benefits, including the following:-

- 1) an identity card or bank card can be produced at a fraction of the cost of a smart card,
- 2) the information on the data carrier is secure and tamper-proof,

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- 3) confirmation concerning the face/finger/voice of the card holder is carried on the card so that no on-line data base is needed,
- 4) it utilises tried and tested technology, and
- 5) if lost or stolen, the unauthorised use of a bank or credit card can readily be prevented.

Some potential uses of the system of the present invention are as follows:-

- a) as a National Carers ID card - this card will contain facial biometrics only and is intended for use by social workers, teachers, nurses, doctors, paramedics, etc. Once established, the use of the PDF format bar code offers unique links to healthcare systems, e.g. drug treatment, cost analysis, etc.
- b) in the Prison Service:
 - 1) as part of a record system which puts a digital image along with facial and/or fingerprint biometrics on to all elements of day-to-day records. This will be of assistance in:-
 - i) transfers - prison-police-prison,
 - ii) Court appearances,
 - iii) medication routines - general and CDs,
 - iv) release documents,
 - v) probation supervision, and
 - vi) Police station attendance verification.

- 2) for Visitors Passes. All prison visitors, either domestic or business, can be issued with an inexpensive pass which can be verified when the visitor leaves the prison.
- 3) as a Prison Staff ID card providing for variable use throughout the prison building. Permits double confirmation at main gates with hands-free access within the main prison complex.
- c) as a National Insurance Card,
- d) for Social Security Payments - as an anti-fraud device,
- e) in education establishments, permitting access to buildings, libraries and/or computers in schools, colleges and universities,
- f) as a travel card - enabling automatic debiting for travel on trains, aeroplanes and buses,
- g) as a cheque card or giro card - enabling cheques to be cashed by persons who do not have bank accounts,
- h) as a bank card - with overprinting on existing cards allowing ATM machines with a camera to verify the user of the card,

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- i) to provide identification for car hire,
- j) as an age card - for those wishing and entitled to obtain access to clubs and/or public houses,
- k) in shops and offices - to restrict access to secure areas and tills,
- l) in industry - for access to computers, time-keeping, etc.,
- m) on passports for humans and animals, such as horses, dogs and cattle,
- n) as a Military ID card,
- o) as a Healthcare record card, and
- p) on prescriptions - with provision for repeat prescriptions and/or information concerning registered addicts included in an overall prescription system.

Claims:-

1. A method of producing and using an identity system, which method includes obtaining images of a plurality of persons, each of which images is obtained using a digital camera linked to a computer programmed to analyse the biometric data in the images to produce a template for each of the persons, converting the templates to multi-dimensional bar codes, applying the multi-dimensional bar codes to data carriers, and scanning the bar codes using scanning devices linked to display means for displaying the images.

2. A method of producing an identity device, which method includes obtaining a plurality of images of a person, each of which images is obtained using a digital camera linked to a computer programmed to analyse the biometric data in the images to produce a plurality of biometric templates, one for each of said images, the computer further being programmed to assess the plurality of biometric templates associated with that person and to recognise differences between the templates, the computer then generating data concerning the two templates of maximum difference, which data is converted into a multi-dimensional bar code which is applied to a data carrier to produce the identity device.

3. A method as claimed in Claim 1 or Claim 2, in which the or each data carrier is in the form of an identification card, bank card, record sheet, airline boarding pass or the like.

4. A method as claimed in any one of the preceding claims, in which the or each data carrier is also printed with a digital photograph of the relevant person.

5. A method as claimed in any one of the preceding claims, in which the multi-dimensional bar code also includes additional biometric data concerning the voice and/or fingerprint of the person concerned.

6. A security system which includes:-

a) a digital camera for obtaining an image of a person at a first point,

b) a computer linked to the digital camera and programmed to analyse the biometric images obtained by the camera to produce a biometric template for each person and to convert the template into a multi-dimensional bar code,

c) means for applying the multi-dimensional bar code to a data carrier,

d) scanning means at a second point for scanning the bar code on each data carrier, and

e) display means linked to the scanning means to display the image associated with the bar code for comparison with the person or a photograph of the person presenting the data carrier.

7. A security system as claimed in Claim 6, in which the digital camera obtains a plurality of images of each person and the computer is programmed to assess the plurality of biometric

templates associated with each person to generate data which is converted into the multi-dimensional bar code.

8. A method of affording security, which method includes:-

a) obtaining an image of each person at a first location using a digital camera,

b) providing a computer which is linked to the digital camera and is programmed to analyse the biometric data in the images to produce a biometric template for each person,

c) converting the template to a multi-dimensional bar code,

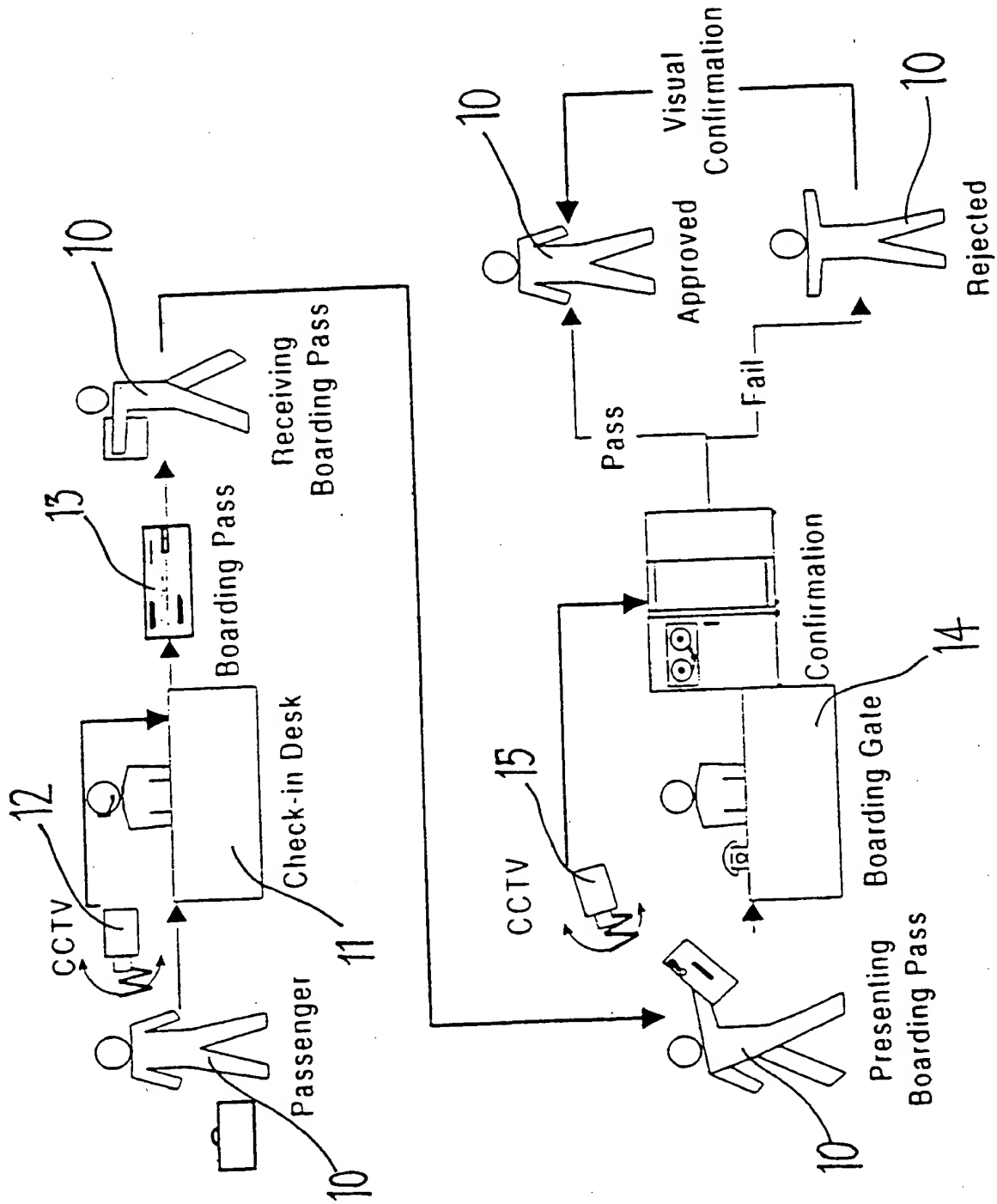
d) applying the multi-dimensional bar code to a data carrier,

e) providing scanning means at a second location for scanning the bar code on each data carrier, and

f) providing display means linked to the scanning means to display the image associated with the bar code.

9. A method of affording security as claimed in Claim 8, as applied to an airport, in which all the information concerning the passengers on a particular aircraft is collated and sent to the airport at which the aircraft is due to land.

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INTERNATIONAL SEARCH REPORT

International Application No.
PCT/GB 99/03722

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G07C9/00 G07B15/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G07C G07B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 401 944 A (WANG YNJIUN P ET AL) 28 March 1995 (1995-03-28) abstract column 2, line 3 - line 58 column 7, line 24 - column 11, line 34; examples	1,2,6,8
A	US 5 635 012 A (CHARLIP ELIOT ET AL) 3 June 1997 (1997-06-03) the whole document	1-6,8
A	EP 0 790 585 A (KALAMAZOO COMPUTER GROUP PLC) 20 August 1997 (1997-08-20) abstract column 5, line 10 - column 6, line 36; figures	1-3,6,8

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

9 March 2000

Date of mailing of the international search report

17/03/2000

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 99/03722

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Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>EP 0 665 124 A (SEKI ELECTRONICS COMPANY LIMIT) 2 August 1995 (1995-08-02) column 1, line 3 -column 3, line 27</p>	1-3

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 99/03722

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